

AMENDMENT UNDER 37 C.F.R. § 1.116
Application No.: 09/867,596
Atty Docket No.: Q61608

REMARKS

The Office Action of August 21, 2003, has been received and its contents carefully considered.

Claims 7 to 26 are all the claims pending in the application, with claims 7 to 20 being withdrawn.

Applicants have amended claim 24 to correct a typographical error. See original claim 4 of the present application.

Claims 21 to 26 have been rejected under 35 U.S.C. § 103(a) as obvious over JP 62-246813A to Yasuhiro et al taken with JP 2000-273351 to Masaru et al.

Applicants submit that these references do not disclose or suggest the presently claimed invention and, accordingly, request withdrawal of this rejection.

The present invention, as defined in independent claim 21, is directed to a carbon powder having a primary particle size of 100 nm or less and an X-ray crystallite plane spacing C_o of less than 0.680 nm, and having a boron content in a range of 0.001 to 5% by mass. The use of boron in a specific amount, as recited in claim 21, enables a high graphitization degree and excellent electrical conductivity to be obtained.

The invention of Yasuhiro et al (JP'813) relates to a method for obtaining a spherical graphite body by adding a boron compound such as boric acid to carbon black and heating the mixture.

It is well known that carbon black cannot be graphitized even by high heat treatment (as described in the present specification at page 3, lines 10-12 and JP'813 page 2, right upper

AMENDMENT UNDER 37 C.F.R. § 1.116

Application No.: 09/867,596

Atty Docket No.: Q61608

column), and only in particular cases, graphite with a plane spacing value of less than 0.680 nm can be obtained. The present specification states at page 14, lines 8-12,

“If a boric acid which is in general easily available is mixed and heat-treated, instead of using boron carbide as the raw material of boron, enough reduction in the C_0 value cannot be attained by the graphitization, and it is difficult to make the C_0 value of less than 0.680 nm.”

Thus, the C_0 value cannot be satisfactorily lowered by using boric acid.

The boric compounds on which experimental data was obtained in JP'813 are only boric acid and borax (sodium borate). Further, JP'813 is silent on the differences in properties between the product obtained by using boric acid and that obtained by using borax. Accordingly, it cannot be anticipated from the teachings of JP'813 that use of a specific boron compound would contribute to obtaining a product excellent in specific properties, such as graphitization degree and electrical conductivity.

On the other hand, JP '351 to Masaru et al teaches a process for producing graphitized carbon black through heat-treating a mixture of carbon black such as acetylene black and a graphitization promoting substance such as boron carbide, boric acid and boron oxide. The Examiner alleges that “[i]t would have been obvious to one of ordinary skill at the time of invention to substitute the boron graphitization promoter of Masauru et al (JP '351) in the process of Yasuhiro et al (JP '813) because it provides the same effect.”

However, the inter-planer spacing value d_{002} obtained in JP'351 is within the range of 0.3413 to 0.3426 nm, as disclosed in Table 1 of JP '351, which is, in terms of C_0 value, within the range of 0.6826 to 0.6852 nm. Therefore, it can be concluded that carbon powder having a

AMENDMENT UNDER 37 C.F.R. § 1.116

Application No.: 09/867,596

Atty Docket No.: Q61608

spacing value C_0 of less than 0.680 nm cannot be produced by the process of JP'351.

Accordingly, one of ordinary skill would not have been motivated to substitute the boron graphitization promoter of JP'351 in the process of JP'813 to obtain carbon powder of a spacing value C_0 of less than 0.680 nm.

The Examiner has acknowledged applicants' argument that there is no motivation to combine the references. The Examiner asserts that motivation exists because JP '351 teaches that boric acid and boron carbide are equivalent as graphitization promoting substances. This assertion by the Examiner, however, does not address the fact that the present application states at page 14, lines 8 to 12, that the two compounds do not achieve the same results.

In support of applicants' argument that boric acid and boron carbide are not equivalent and do not achieve the same results, applicants direct the Examiner's attention to Tables 1 and 2 at pages 28 and 30 of the present specification, and especially Comparative Examples 3, 4, 6 and 7 where boric acid was employed and Invention Examples 3, 4, 5 and 6 where boron carbide was employed.

As the present specification mentions in the Background Art section, at page 3, lines 13-24, JP '813 teaches adding a boric acid to carbon black to obtain a slurry and heating the slurry at 1,000 to 2,000°C. According to JP '813, a slurry prepared from a mixture obtained by adding boric acid (Example 1 of JP '813) or sodium borate (Example 2 of JP '813) to carbon black by using water was dried by evaporating the water and subjected to heat treatment at 2,000 to 3,000°C.

AMENDMENT UNDER 37 C.F.R. § 1.116

Application No.: 09/867,596

Atty Docket No.: Q61608

Similarly to this, in Comparative Examples 3, 4, 6 and 7 of the present specification, as disclosed at page 27, lines 6-18, a slurry was prepared by mixing boric acid with carbon black in hot water of 70°C, dried at 130°C, and then measured on the weight to determine the amount of boric acid. Subsequently, each sample was placed in a graphite box and subjected to heat treatment at the temperature shown in Table 1 (2,690°C, 3,010°C, 3,000°C and 2,890°C, respectively). As can be seen from Table 2 at page 30 of the present specification, each of the carbon powders obtained in Comparative Examples 3, 4, 6 and 7 had a C_o of more than 0.680nm, which does not satisfy the recitations of claim 21.

In addition, although boric acid and sodium borate are soluble in water, boron carbide (B_4C) is not soluble in water. See the Merck Index, 9th Edition, pages 173 (boric acid) and 1110 (sodium borate), copies of which are attached. According to the Merck Index, 9th Edition, page 175, a copy of which is attached hereto, boron carbide is “remarkably resistant to chemical action” and “not attacked by hot HF , HNO_3 or $HCrO_4$ ”, and so does not readily dissolve to form a solution. Therefore, it is almost impossible to prepare a solution of boron carbide to be mixed with carbon black to form a slurry. Accordingly, boron carbide is not equivalent to boron acid with respect to water solubility, and how it can be mixed with another component.

In the Invention Examples of the present specification, as described in the specification at page 26, line 24 to page 27, line 5, a boron carbide ground into powder having an average particle size of about 20 μm is added to carbon black and mixed in a dry system. JP ‘813 neither describes nor suggests such a technical feature. Thus, JP ‘813 does not describe a suitable method that can be used with boron carbide to arrive at the present invention.

AMENDMENT UNDER 37 C.F.R. § 1.116

Application No.: 09/867,596

Atty Docket No.: Q61608

From the viewpoint of the physical properties values of boron compounds, i.e., melting point of boric acid (171°C, Merck Index at page 173), melting point of sodium borate (75°C, Merck Index at page 1110), and melting point of boron carbide (2,350°C, Merck Index at page 175) and boiling point of boron carbide (3,500°C, Merck Index at page 175), the boron compound suitably used to obtain the Invention Examples of the present specification where the temperature of 2,500°C or higher is used to effect graphitization is not boric acid or sodium borate, but boron carbide.

In order to obtain the carbon powder of the present claims, applicants have found that the method of producing the carbon powder is important.

Applicants have found that certain process conditions lead to the obtaining of the carbon powder of the present invention, and have found that when these process conditions are not employed, applicants have been unable to obtain the carbon powder of the present invention.

For example, as disclosed at page 13, line 20 to 14, line 2, the heat-treatment temperature of the mixture of carbon black and boron carbide must be 2500°C or more. If the temperature is less than this range, the graphitization does not proceed and a graphite fine carbon powder having a C_0 value of less than 0.680 cannot be obtained. Neither JP '813 nor JP '351 discloses or suggests the use of such a temperature with boron carbide to achieve a C_0 value of less than 0.680 nm.

The temperature range used in the heat treatment to effect graphitization in JP '351 is from 2,000°C to 2,500°C, as recited, for example, in claim 3 of JP '351, which is lower than the temperature that was employed to produce the Invention Examples of the present specification.

AMENDMENT UNDER 37 C.F.R. § 1.116

Application No.: 09/867,596

Atty Docket No.: Q61608

In Example 1 of JP '351, boron carbide as a graphitization-promoting substance is mixed with carbon black and the mixture was heated at 2,400°C. The d002 values obtained in Example 1 of JP '351 was 0.3413 nm, as described in Table 1 of JP '351, corresponding to a C₀ value of .6826 nm, which does not satisfy the recitations of claim 21.

JP '351 also refers to JP 6-140047 A as describing a prior art technique in which carbon black is heated and graphitized at a temperature of 2700°C or more. Comparative Example 2 of JP '351 was produced in the same manner as Example 1 of JP '351, except that the boron carbide graphitization promoter was not employed, and the temperature used during the heat treatment was 2800°C, and thus in accordance with the teachings of JP '047. As can be seen from Table 1 of JP '351, the d002 value was 0.3415, corresponding to a C₀ value of 0.6830, which does not satisfy the recitations of claim 21. Thus, the use of a high temperature in the absence of boron carbide was not sufficient to arrive at a C₀ value that satisfies the present claims.

Further, comparative Example 1 of the present specification describes that the carbon black to which boron carbide was added, in an amount of 7 mass% boron, which is the same amount that was added in Invention Example 3, was treated at 2,180°C, which is within the temperature range of JP '351.

The C₀ value for Comparative Example 1 was 0.6890 as shown in Table 2 of the present specification, which does not satisfy the recitations of claim 21, and the boron content in the final product was 6.9 mass%, which also does not satisfy the recitations of claim 21. It seems that due to the heating temperature of 2,180°C in Comparative Example 1, which is lower than the melting point of 2,350°C of boron carbide, the boron carbide remained solid in the final product.

AMENDMENT UNDER 37 C.F.R. § 1.116

Application No.: 09/867,596

Atty Docket No.: Q61608

Comparative Example 1 thus illustrates the importance of temperature in that even if one starts with the same boron carbide that is employed in the present invention, in the same initial amount that is within the range that is employed to produce the Invention Examples, one still would not be led to the present invention if the correct temperature is not employed.

Comparative Example 1 illustrates that a combination of factors were required to arrive at the present invention. Applicants submit that the cited JP '813 and JP '351 do not teach or suggest that one of ordinary skill in the art would have been led to making this combination to arrive at the claimed invention with a C_0 value of less than 0.680 nm, which value is not disclosed or suggested in either JP '813 or JP '351.

Further, although JP '351 discloses in Example 1 that boron carbide and carbon black were mixed, JP '351 does not include a specific description about the process of mixing boron carbide with carbon black, and neither teaches nor suggests grinding boron carbide into powder or controlling the particle size of the powder. Accordingly, JP '351, just as JP '813, does not provide an enabling method that teaches one of ordinary skill in the art how to use boron carbide to arrive at the present invention.

Applicants have previously argued that JP '351 neither describes nor suggests the boron content in the final product. The Examiner argues that the final boron content will be the same as in the present invention by following the teachings of JP '351, which disclose an initial boron content within the same range as the final boron content of the present claims. At the present time, applicants no longer assert that JP '351 differs from the present invention with respect to the final boron content.

AMENDMENT UNDER 37 C.F.R. § 1.116
Application No.: 09/867,596
Atty Docket No.: Q61608

Applicants maintain that neither JP '813 nor JP '351 obtains carbon particles having a C_0 value of 0.680 nm or less (and a primary particle size of 100 nm or less as recited in claim 2), and neither JP '813 nor JP '351 anticipates or suggests the present invention.

The difference between the present invention and JP '813 and JP '351, as shown by the Comparative Examples of the present specification and the data in JP '351, lies in that the C_0 values obtained in JP '351 and in the Comparative Examples (1, 3, 4, 6 and 7), which can be said to be similar to the teachings of JP '813 and JP '351, are more than 0.680 nm, while the C_0 values obtained according to the present invention are 0.680 nm or less. Applicants submit the present invention could not have been obvious to one of ordinary skill at the time of the present invention because neither of these documents disclose or suggest such a C_0 value, and neither disclose or suggest how to obtain such a C_0 value, and, therefore, the combination of the teachings of these two documents still would not result in obtaining the present invention.

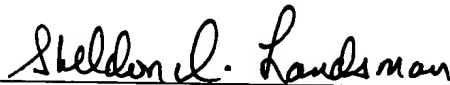
In view of the above, applicants request withdrawal of the rejection of claims 21 to 26 over JP'813 and JP'351.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

AMENDMENT UNDER 37 C.F.R. § 1.116
Application No.: 09/867,596
Atty Docket No.: Q61608

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,


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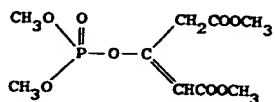
Date: November 21, 2003

Merck Index 9th Edition

Borneol

1350

C 38.31%, H 5.36%, O 45.36%, P 10.98%. Prepn: Gilbert, U.S. pat. 2,891,887 (1959 to Allied).



Liquid; bp₁₇ 155-164°; bp₂ 155-165° (tech grade). Miscible with methanol, ethanol, acetone, xylene. Practically insol in water, petr ether, kerosene. LD₅₀ orally in rats: 32 mg/kg. Toxic Substances List, H. E. Christensen, Ed. (1972) p 202. USE: Insecticide.

1345. Bonducin. Guilandinin. C₂₀H₂₈O₈; mol wt 396.42. C 60.59%, H 7.12%, O 32.29%. Glucoside from seed cotyledons of *Caesalpinia bonducella* Flem., *Leguminosae*. Refs: Heckel, Schlagdenhauffen, *J. Pharm. Chim.* 14, 115 (1886); Greshoff, *Mededeel. Lands Plant.* 25, 68 (1898); Boorsma, *ibid.* 52, 60 (1902); Katti, *J. Indian Chem. Soc.* 7, 207 (1930); Ghatak, *C.A.* 29, 7578 (1935).

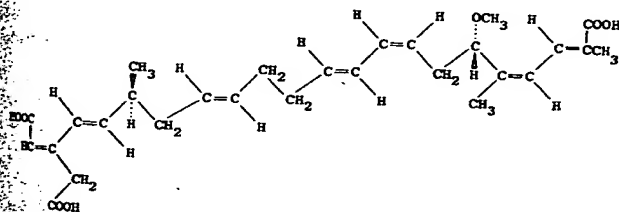
White amorphous solid, mp 119-120°. [α]_D²⁰ +25-26° (ethanol). Almost insol in water, petr ether; freely sol in alcohol, acetone, chloroform, acetic acid, fatty oils; slightly sol in ether, carbon disulfide.

1346. Bone Oil. Dippel's oil; oil of hartshorn; animal oil. Obtained by the destructive distillation of bones during the prepn of animal charcoal or bone black. Contains pyrolyse, stearonitrile, valeronitrile, pyridine, aniline, methylamine and other nitrogenous compds; for list see Weidel, *Ciamician, Ber.* 13, 65 (1880).

Nearly black liquid; offensive, fetid odor. d 0.970. Starts boiling at 80° releasing NH₃. From 180-250° ammonium cyanide and carbonate are given off. The residue is used in making Brunswick black. Freely sol in alcohol, ether, fat solvents, oils. Used as denaturant for alcohol.

Note: Fatty bone oil, obtained by expressing the fat from the bones of cattle, is a clear oil of good lubricating qualities and low congealing point, used by watchmakers.

1347. Bongkreic Acid. 3-Carboxymethyl-17-methoxy-6,18,21-trimethyl-docosanoic acid; BA. C₂₈H₅₀O₄; mol wt 486.61. C 69.11%, H 7.87%, O 23.02%. One of the two toxic antibiotic principles produced by *Pseudomonas cocovenenans* on partially defatted coconut; the other being toxoflavin (q.v.). Name derived from "bongkreik", a molded coconut product from Indonesia which becomes highly poisonous when *P. cocovenenans* outgrows the mold. Isolat: van Veen, Mertens, *Rec. Trav. Chim.* 53, 257 (1934); 54, 373 (1935); Nugteren, Berends, *ibid.* 76, 13 (1957). Purification and properties: Lijmbach *et al.*, *Tetrahedron* 26, 5993 (1970). Structural studies: eidem, *ibid.* 27, 1839 (1971). Revised structure: De Bruijn *et al.*, *ibid.* 29, 1541 (1973). Absolute configuration: Zylber *et al.*, *Experientia* 29, 387 (1973). Influence on carbohydrate metabolism: van Veen, Mertens, *Arch. Neer. Physiol.* 21, 73 (1936). C.A. 30, 3880⁹ (1936); inhibition of adenine nucleotide translocation: Henderson, Lardy, *J. Biol. Chem.* 245, 1319 (1970); Klingenberg *et al.*, *Biochem. Biophys. Res. Commun.* 39, 363 (1970).



White, amorphous solid, melting traject 50-60°. uv max (methanol): 237, 267 nm (ε 32,000, 36,700). [α]_D²⁵ +162.5°. LD₅₀ i.v. in mice: 1.41 mg/kg.

1348. Boric Acid. Boracic acid; orthoboric acid; Boron trioxide. BH₃O₃; mol wt 61.84. B 17.50%, H 4.88%, O 77.62%. Occurs in nature as the mineral *sassolite*. Colorless, odorless, transparent crystals, or white granules

or powder; slightly unctuous to the touch. mp about 171°. Phase diagram for the B₂O₃-H₂O system: Kracek *et al.*, *Am. J. Sci.* 35A, 143 (1938). Volatile with steam. pH: 5.1 (0.1 molar). One gram dissolves in 18 ml cold, 4 ml boiling water, in 18 ml cold, 6 ml boiling alcohol, in 4 ml glycerol; soly in water is increased by HCl, citric or tartaric acids. Soly of boric acid in glycerol solns of various concns: Sciarra, Elliott, *J. Am. Pharm. Assoc. (Sci. Ed.)* 49, 116 (1960). LD₅₀ orally in rats: 5.14 g/kg. Smyth *et al.*, *Am. Ind. Hyg. Assoc. J.* 30, 470 (1969).

Incompat. Alkali carbonates and hydroxides.

Human Toxicity: Ingestion or absorption may cause nausea, vomiting, diarrhea, abdominal cramps, erythematous lesions on skin and mucous membranes, circulatory collapse, tachycardia, cyanosis, delirium, convulsions, coma. Death has occurred from < 5 g in infants and from 5 to 20 g in adults. Chronic use may cause borism (dry skin, eruptions, gastric disturbances). E. Browning, *Toxicity of Industrial Metals* (Appleton-Century-Crofts, New York, 2nd ed., 1969) pp 90-97.

USE: For weatherproofing wood and fireproofing fabrics; as a preservative; manuf cements, crockery, porcelain, enamels, glass, borates, leather, carpets, hats, soaps, artificial gems; in nickeling baths; cosmetics; printing and dyeing, painting; photography; for impregnating wicks; electric condensers; hardening steel.

THERAP CAT: Astringent, antiseptic.

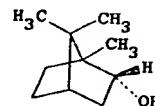
THERAP CAT (VET): Antibacterial and antifungal. Used chiefly in aqueous solution or powders for external use.

1349. Boric Anhydride. Boron oxide; boron trioxide; boric oxide; boron sesquioxide. B₂O₃; mol wt 69.64. B 31.07%, O 68.93%. Improperly called *anhydrous boric acid* or *fused boric acid*. Prepn of crystalline form: McCulloch, *J. Am. Chem. Soc.* 59, 2650 (1937).

Colorless, brittle, vitreous, semitransparent, hygroscopic lumps or hard, white crystals. d (amorph) 1.8; d (cryst) 2.46. mp (cryst) 450°. Slowly sol in 30 parts cold, or 5 parts boiling water; sol in alcohol, glycerol. Keep dry.

USE: In metallurgy; in analysis of silicates to determine SiO₂ and alkalies; in blowpipe analysis.

1350. Borneol. *endo-1,7,7-Trimethylbicyclo[2.2.1]heptan-2-ol*; *endo-2-bornanol*; *endo-2-camphanol*; *endo-2-hydroxycamphane*; bornyl alcohol; Baros camphor; Sumatra camphor; Borneo camphor; Dryobalanops camphor; Bhimsam camphor; Malayan camphor; camphol. C₁₀H₁₈O; mol wt 154.24. C 77.86%, H 11.76%, O 10.37%. The dextro-rotatory form which predominates occurs in the oil from *Dryobalanops aromatica* Gaertn., *Dipterocarpaceae*, and in many other plants; the levorotatory form comes from *Blumea balsamifera* (L.) DC., *Compositae*: E. Gildemeister, F. Hoffman, *Die Atherischen Ole* (Schimmel, Leipzig, 3rd ed., 1928) pp 475-481. Racemic borneol is prepd synthetically by reduction of camphor: Truett, Moulton, *J. Am. Chem. Soc.* 73, 5913 (1951); Ziegler *et al.*, *Ann.* 623, 9 (1959); Ziegler, Brit. pat. 803,178 (1958); from pinene: Schwyzer, *Pharm. Ztg.* 75, 1275 (1930). Configuration (isoborneol = *exo*-form; borneol = *endo*-form): Toivonen *et al.*, *Acta Chem. Scand.* 3, 991 (1949). Review: J. L. Simonsen, *The Terpenes* vol. II (University Press, Cambridge, 2nd ed., 1949) pp 349-365.



d-borneol

d-Form, hexagonal plates from petr ether, mp 208°. Peculiar peppery odor and burning taste somewhat resembling that of mint. Sublimes, but is less volatile than camphor. d₄²⁰ 1.011. bp 212°. [α]_D²⁰ +37.7° (c = 5 in alc); [α]_D²⁵ +44.4° (c = 0.5 in toluene). Almost insol in water. Sol in alc (176 parts dissolve in 100 parts w/w of abs alc), ether, petr ether (about 1:6), benzene (about 1:5), toluene, acetone, decalin, tetralin. LD orally in rabbits: 2 g/kg.

8331. Sodium Bisulfide. Sodium sulfhydrate; sodium hydrosulfide; sodium hydrogen sulfide. HNaS ; mol wt 56.07. H 1.80%, Na 41.02%, S 57.18%. NaSH . Prep'd from sodium ethylate and hydrogen sulfide: Rule, *J. Chem. Soc.* 99, 558 (1911); Teichert, Klemm, *Z. Anorg. Allgem. Chem.* 243, 86 (1939); Eibeck, *Inorg. Syn.* 7, 128 (1963). The technical grade may be obtained by reacting sodium bisulfate with calcium sulfide in the cold or by saturating NaOH solns with H_2S .

Rhombohedral-cubic crystals. White to colorless. Odor of hydrogen sulfide. Very hygroscopic. Readily hydrolyzed in moist air to NaOH and Na_2S . d 1.79. Turns yellow upon heating in dry air, changing to orange at higher temps. mp 350° forming a black liquid. Sol in water, alcohol, ether. Gives a blue-green soln in dimethylformamide.

Dihydrate, needles or flakes, mp 55°. Completely and rapidly sol in water, alcohol, ether. *Note:* The commercial product is usually the dihydrate. Can be shipped in lacquer-lined steel drums.

Trihydrate, shiny rhombs, mp 22°.

USE: Dehairing hides; desulfurizing viscose rayon; in the manuf of sulfur-contg dyes and other thio compds such as thioamides, thiourea, thioglycolic acid, thio- and dithiobenzoic acids, sodium thiosulfate.

8332. Sodium Bisulfite. Sodium acid sulfite. HNaO_2S ; mol wt 104.07. H 0.97%, Na 22.10%, O 46.13%, S 30.81%. NaHSO_3 . The bisulfite of commerce consists chiefly of sodium metabisulfite, $\text{Na}_2\text{S}_2\text{O}_5$, and for all practical purposes possesses the same properties as the true bisulfite.

White, cryst powder; SO_2 odor; disagreeable taste; on exposure to air it loses some SO_2 and is gradually oxidized to sulfate. d 1.48. Sol in 3.5 parts cold water, 2 parts boiling water, in about 70 parts alcohol. Its aq soln is acid. *Keep well closed and in a cool place. Incompat:* Acids, oxidizers. LD_{50} i.v. in rats: 115 mg/kg, Hoppe, Goble, *J. Pharmacol. Exp. Ther.* 101, 101 (1951).

USE: As disinfectant and bleach, particularly for wool; in dyeing for preparing hot and cold indigo vats; in paper-making in place of sodium hyposulfite to remove Cl from bleached fibers; as stripper (reducer) in laundering; to remove permanganate stains from skin and clothing; to render certain dyes sol; manuf sodium hydrosulfite; coagulating rubber latex; as preservative for deteriorative liqs or solns used for technical purposes; as antiseptic in fermentation industries. *Caution:* Conc'd solns are irritating to skin, mucous membranes.

THERAP CAT: Pharmaceutic aid (antioxidant).

8333. Sodium Bitartrate. Sodium acid tartrate. $\text{C}_4\text{H}_5\text{NaO}_6$; mol wt 172.07. C 27.92%, H 2.93%, Na 13.36%, O 55.79%. $\text{NaHC}_4\text{H}_4\text{O}_6$.

Monohydrate, white crystals. Sol in about 9 parts water, 2 parts boiling water; almost insol in alcohol. The aq soln is acid.

USE: For detecting potassium; in nutrient media.

8334. Sodium Borate. Sodium biborate; sodium pyroborate; sodium tetraborate. $\text{B}_4\text{Na}_2\text{O}_7$; mol wt 201.27. B 21.50%, Na 22.84%, O 55.65%. $\text{Na}_2\text{B}_4\text{O}_7$.

Anhydr, fused sodium borate, borax glass, fused borax. Powder or glass-like plates becoming opaque on exposure to air. Slowly sol in water.

Decahydrate, borax. Hard odorless crystals, granules or cryst powder; efflorescent in dry air, the crystal often being coated with white powder. d 1.73. mp when rapidly heated at 75°; at 100° loses $5\text{H}_2\text{O}$; at 150° loses $9\text{H}_2\text{O}$; becomes anhydr at 320°. One gram dissolves in 16 ml water, 0.6 ml boiling water, about 1 ml glycerol; insol in alcohol. The aq soln is alkaline to litmus and phenolphthalein. pH about 9.5. Borax dissolves many metallic oxides when fused with them. *Incompat:* Acids, alkaloidal and metallic salts.

Human Toxicity: Ingestion of 5 to 10 g by young children can cause severe vomiting, diarrhea, shock, death. *See also Boric Acid.*

USE: Soldering metals; manuf glazes and enamels; tanning; in cleaning compds; artificially aging wood; as preservative, either alone or with other antiseptics against wood fungus; fireproofing fabrics and wood; curing and preserving skins.

THERAP CAT: Pharmaceutic aid (alkalizing agent).

THERAP CAT (VET): Has been used as antiseptic, detergent, astringent for mucous membranes.

8335. Sodium Borate S lution Compound. Dobell's soln. Made from 1.5 g sodium borate, 1.5 g sodium bicarbonate, 0.3 ml liquefied phenol, 3.5 ml glycerol and water to make 100 ml.

Yellowish, clear liquid.

THERAP CAT: Wash for mucous membranes.

THERAP CAT (VET): Has been used as a nonirritant wash for mucous membranes.

8336. Sodium Borohydride. Sodium tetrahydroborate. BH_3Na ; mol wt 37.83. B 28.58%, H 10.65%, Na 60.77%. NaBH_4 . Prepared from methyl borate and sodium hydride at elevated temps: Schlesinger *et al.*, *J. Am. Chem. Soc.* 75, 205 (1953). Review of sodium and other metal tetrahydroborates: James, Walbridge, *Prog. Inorg. Chem.* 11, 99-231 (1970).

Hygroscopic, cubic crystals forming a dihydrate, mp 36-37°. The anhydr material (d 1.074) is stable in dry air to 300°; dec slowly at 400° and rapidly at 500°. Supports combustion. Sol (w/w) in water at 25°: 55%; at 60°: 88.5%; liq ammonia at 25°: 104%; ethylenediamine at 75°: 22%; morpholine at 25°: 1.4%; pyridine at 25°: 3.1%; methanol at 20°: 16.4% (reacts); ethanol at 20°: 4.0% (reacts slowly); tetrahydrofurfuryl alcohol at 20°: 14.0% (reacts slowly); tetrahydrofuran at 20°: 0.1%; diglyme at 25°: 5.5%; dimethylformamide at 20°: 18.0%. Aq solns are most stable in the presence of small amounts of NaOH (0.2% for a nearly sat'd soln contg 44% NaBH_4) and can be kept for several days. Solns are rapidly dec by boiling.

USE: Reducing agent for aldehydes, ketones and Schiff bases in nonaqueous solvents. Also reduces acids, esters, acid chlorides, disulfides, nitriles, inorganic anions. Further used to generate diborane, as foaming agent, as scavenger for traces of aldehyde, ketones and peroxides in organic chemicals.

8337. Sodium Bromate. BrNaO_3 ; mol wt 150.91. Br 52.96%, Na 15.24%, O 31.81%. NaBrO_3 . The article of commerce contains about 99% NaBrO_3 .

Colorless, odorless crystals, white granules or cryst powder. d 3.34. mp 381° with dec and liberation of oxygen. Sol in 2.5 parts water, 1.1 parts boiling water. The aq soln is neutral. *Keep from contact with organic matter.*

USE: As a mixture with sodium bromide for dissolving gold from its ores. *Caution:* See Potassium Bromate.

8338. Sodium Bromide. Sedoneural. BrNa ; mol wt 102.91. Br 77.65%, Na 22.35%. NaBr . Prep'd commercially by adding some excess bromine to a sodium hydroxide soln forming a mixture of bromide and bromate. The reaction products are evaporated to dryness and treated with carbon to reduce the bromate to bromide. *Ref:* van der Meulen, U.S. pat. 1,775,598 (1930); Robertson, *Ind. Eng. Chem.* 34, 133 (1942); T. O. Soine, C. O. Wilson, *Roger's Inorganic Pharmaceutical Chemistry* (Lea & Febiger, Philadelphia, 8th ed., 1967) pp 213-216.

White crystals, granules or powder; saline, feebly bitter taste. Absorbs moisture from air but is not deliquescent. d 3.21. mp 755°; volatilizes at somewhat higher temp. One gram dissolves in 1.1 ml water, about 16 ml alcohol, 6 ml methanol. The aq soln is practically neutral. pH 6.5-8.0. *Keep well closed.* From water of room temp, sodium bromide crystallizes with $2\text{H}_2\text{O}$ in the form of colorless crystals. *Incompat:* Acids, alkaloidal and heavy metal salts. LD_{50} orally in rats: 3.5 g/kg, Smith, Hambourger, *J. Pharmacol. Exp. Ther.* 55, 200 (1935).

USE: In photography.

THERAP CAT: Sedative, hypnotic, anticonvulsant.

THERAP CAT (VET): Sedative. Has been used to control convulsions, chorea, hysteria.

8339. Sodium Cacodylate. [(Dimethylarsino)oxy]sodium As-oxide; sodium dimethylarsionate; Arsecodile; Arsicodile; Arsyecodile; Rad-e-cate; Silvisar. $\text{C}_2\text{H}_5\text{AsNaO}_2$; mol wt 159.98. C 15.02%, H 3.78%, As 46.82%, Na 14.37%, O 20.00%. An organic compd of arsenic yielding inorganic, trivalent arsenic in the body (is excreted partly unchanged, also yields dimethylarsine oxide). Prep'd by the distillation of a mixture of arsenic trioxide and potassium acetate which

Bostrycoidin

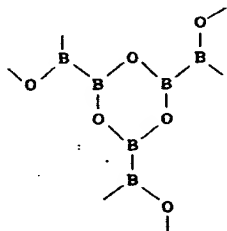
Reacts vigorously with fused sodium peroxide, or with a fusion mixture of sodium carbonate and potassium nitrate.
USE: In nuclear chemistry as neutron absorber, in Ignitron rectifiers, in alloys, usually to harden other metals.

1358. Boron Carbide. Norbide. CB_4 ; mol wt 55.29. C 21.72%, B 78.28%. B_4C . Usually prep'd in an electric furnace at 2500° according to the equation $2\text{B}_2\text{O}_3 + 7\text{C} \rightarrow \text{B}_4\text{C} + 6\text{CO}$: Ridgway, *Trans. Electrochem. Soc.* 66, 117-133 (1934); also formed by reducing boric anhydride with magnesium in the presence of carbon: Dawihl, Ger. pat. 752,324 (1942 to Krupp); BIOS rept. no. 925, p 22 (1947). Lab prep'n by the reduction of boron trichloride with hydrogen in the presence of carbon or hydrocarbons: Bell Labs. Record 28, 477 (1950). Comprehensive monograph: P. W. Gilles, *High Temperature Chemistry of the Binary Compounds of Boron*, Advances in Chemistry Series no. 32, (ACS, Washington, D.C., 1961).

Black shiny rhombohedra or octahedra. d_4^{25} 2.508-2.512. mp 2350° (no decompn); bp > 3500°. Its hardness is less than that of industrial diamonds, but higher than the hardness of silicon carbide: ca 5,000 kg/mm², or Mohs' hardness scale = 9.3. Less brittle than most ceramics. Remarkably resistant to chemical action. Not attacked by hot HF , HNO_3 or HCrO_4 . Decomposed by molten alkalis at red heat. Does not burn in oxygen flame.

USE: Abrasive. In the manuf of hard and chemicals-resistant ceramics or wear-resistant tools. Finely pulverized B_4C can be molded under (considerable) pressure and heat.

1359. Boron Monoxide. $(\text{BO})_x$; B 40.34%, O 59.66%. Prep'd in quantitative yield by dehydration of tetrahydroxyboron at 250° at reduced pressure: Wartik, Apple, *J. Am. Chem. Soc.* 77, 6400 (1955); prep'n and proposed structure: McCloskey et al., *ibid.* 83, 4750 (1961).



Fluffy white solid. Hygroscopic, converts back to tetrahydroxyboron on reaction with water. One gram dissolves in 100 ml methanol, in 100 ml warm ethanol or 100 ml warm isopropyl alcohol. Practically insol in dimethylamine and methyl borate. Vaporizes at 1300-1500° into gaseous B_2O_3 .

1360. Boron Nitride. BN; mol wt 24.83. B 43.58%, N 56.42%. Prep'd by igniting comp'ds of boron with comp'ds of nitrogen: Taylor, U.S. pat. 2,855,316 (1958 to Carborundum Co.). Reviews: Giardini, *U.S. Bur. Mines, Inform. Circ. No. 7664*, 13 pp (1953); K. Niedenzu, J. W. Dawson, *Boron-Nitrogen Compounds* (Academic Press, New York, 1965) pp 147-153.

Crystals with hexagonal, graphite lattice is most common form. Borazon, cubic crystalline modification, is probably the hardest substance known. There exists also an amorphous modification. mp 3000°. Begins to sublime at a temp slightly below 3000°. Begins to dissociate *in vacuo* at about 2700°. The chemical behavior of BN is dependent on the method of prep'n. Not attacked by mineral acids, water; in general resistant to chemical attack. Hot conc'd alkali cleaves boron-nitrogen bond. Oxidation in air begins above 1200°. See Niedenzu, Dawson, *loc. cit.*

USE: Manuf of alloys; in semiconductors, nuclear reactors, lubricants.

1361. Boron Tribromide. BBr_3 ; mol wt 250.57. B 4.32%, Br 95.68%. Prep'n: Gamble, *Inorg. Syn.* 3, 27 (1950); Becher in *Handbook of Preparative Inorganic Chemistry*, Vol. 1, G. Brauer, Ed. (Academic Press, New York, 2nd ed., 1963) p 781. Review of boron halides: Massey, *Advan. Inorg. Chem. Radiochem.* 10, 1-152 (1967).

Colorless, fuming liquid; dec by water or alcohol. mp -46.0°; bp 90°. d_4^{20} 2.698. Vapor pressure data: Barber et al., *J. Chem. Eng. Data* 9, 137 (1964).

USE: Manuf of diborane; ultra high purity boron.

1362. Boron Trichloride. BCl_3 ; mol wt 117.19. B 9.23%, Cl 90.77%. Prep'n: Gamble, *Inorg. Syn.* 3, 27 (1950). Reviews: Gerrard, Lappert, *Chem. Rev.* 58, 1081-1111 (1958); Massey, *Advan. Inorg. Chem. Radiochem.* 10, 1-152 (1967). Colorless, fuming liquid at low temp; dec by water or alcohol. bp 12.5°. mp -107°. d_4^{25} 1.35. d_4^{20} 1.3728: Ward, *J. Chem. Eng. Data* 14, 167 (1969).

USE: Manuf and purification of boron; as catalyst for organic reactions; in semiconductors; in bonding of iron; steels; in purification of metal alloys to remove oxides, nitrides and carbides.

1363. Boron Trifluoride. BF_3 ; mol wt 67.82. B 15.95%, F 84.05%. A strong Lewis acid. Prep'n: Swinehart, U.S. pats. 2,148,514, 2,196,907 (1939, 1940 to Harshaw Chemical); Booth, Wilson, *Inorg. Syn.* 1, 21 (1939); Kwasnik in *Handbook of Preparative Inorganic Chemistry*, Vol. 1, G. Brauer, Ed. (Academic Press, New York, 2nd ed., 1963) pp 219-222; Wiesboeck, U.S. pat. 3,690,821 (1972 to U.S. Steel). Dihydrate: McGrath et al., *J. Am. Chem. Soc.* 66, 1263 (1944). Reviews: Booth, Martin, *Boron Trifluoride and Its Derivatives* (John Wiley & Sons, 1949), 296 pp; Booth in *Fluorine Chemistry*, Vol. 1, J. Simons, Ed. (Academic Press, New York, 1950) pp 201-224; Topchiev et al., *Boron Fluoride and Its Compounds as Catalysts in Organic Chemistry* (Pergamon Press, 1959) 326 pp; Martin in Kirk-Othmer, *Encyclopedia of Chemical Technology*, Vol. 9 (Interscience, New York, 2nd ed., 1966) pp 554-562; Massey, *Advan. Inorg. Chem. Radiochem.* 10, 1-152 (1967).

Colorless gas. Pungent, suffocating odor. Corrosive to skin. Avoid inhalation! Forms dense white fumes in moist air. bp -127.1°. bp -100.4°. d_4^{25} (-100.4°; liq) 1.57. d (gas at STP) 3.07666 g/l. Soly in water (0°): 332 g/100 g; some hydrolysis occurs to form fluoboric and boric acids. Soly in anhydrous H_2SO_4 : 1.94 g/100 g acid. Forms solid complex with nitric acid ($\text{HNO}_3 \cdot 2\text{BF}_3$). Sol in most saturated and halogenated hydrocarbons and in aromatic comp'ds. Polymerizes unsaturated molecules. Easily forms coordination complexes with molecules having at least one unshared pair of electrons. Reacts with incandescence when heated with alkali metals or alkaline earth metals except magnesium.

USE: To protect molten magnesium and its alloys from oxidation; as a flux for soldering magnesium; as a fumigant; in ionization chambers for the detection of weak neutrons. By far the largest application of boron trifluoride is in catalysis with and without promoting agents. Caution: May be irritating to eyes, mucous membranes.

1364. Boron Trifluoride Etherate. *Boron fluoride ethyl ether*; boron fluoride etherate; ethyl ether-boron trifluoride complex. $\text{C}_4\text{H}_{10}\text{BF}_3\text{O}$; mol wt 141.94. C 33.85%, H 7.10%, B 7.62%, F 40.16%, O 11.27%. $(\text{CH}_3\text{CH}_2)_2\text{O} \cdot \text{BF}_3$. Prep'd by vapor-phase reaction of anhyd ether with BF_3 : Laubengayer, Finlay, *J. Am. Chem. Soc.* 65, 884 (1943).

Fuming liquid, immediately hydrolyzed by moisture in air. d_4^{25} 1.125. bp 125.7°. mp -60.4°. n_D^{20} 1.348. Heat of formation: 12.5 kcal. Heat of soln at 0° in ether: 2.7 kcal.

USE: Catalyst in acetylation, alkylation, polymerization, dehydration, and condensation reactions. Caution: On decomposition forms highly toxic fumes of fluorides.

1365. Bostrycoidin. 6,9-Dihydroxy-7-methoxy-3-methylbenz[glisoquinoline-5,10-dione; 5,8-dihydroxy-6-methoxy-3-methyl-2-aza-9,10-anthraquinone. $\text{C}_{15}\text{H}_{11}\text{NO}_5$; mol wt 285.25. C 63.16%, H 3.89%, N 4.91%, O 28.04%. Antibiotic substance produced by *Fusarium bostrycoides*: Hamilton et al., *Antibiot. & Chemother.* 3, 853 (1953); Cajori et al., *J. Biol. Chem.* 208, 107 (1954). Structure: Arsenaull, *Tetrahedron Letters* 1965, 4033.

